

COMBUSTION

Project Fact Sheet



HIGH-EFFICIENCY, ULTRA-LOW-EMISSION, INTEGRATED PROCESS HEATER SYSTEM

BENEFITS

- Potentially save 110 trillion Btu per year in the U.S. refining and chemicals industries (with 100% market penetration)
- Decrease CO₂ emissions by 7.2 million tons annually
- Decrease NO_x emissions by 200,000 tons annually (85% reduction in the chemicals and refining industries)
- Avoid \$1.5 billion in capital costs via NO_x reduction throughout the U.S. refining and chemicals industries
- Save \$100,000 in capital and labor per installation by using PEMS vs CEMS technology; \$200 million throughout U.S. refining and chemicals industries.

APPLICATIONS

Process heaters are widely used in a broad range of refining and chemicals processes. Advanced system components (burners, sensors, control systems, and heat exchangers) will be developed for use in both new and retrofit applications.

A NEW GENERATION OF SMART, INTEGRATED BURNER/ FIRED-HEATER SYSTEMS

The refining and chemical industries rely on process heaters to heat liquids and induce chemical reactions during production processing. Process heaters in these two industries consume roughly 2 quadrillion Btu annually—about 40% of all energy used for process heat in the United States. Despite this high energy use, fired heater designs have not changed appreciably in the last 20 years, and few new heaters are built each year. Faced with the prospect of more stringent environmental regulations, the chemical and refining industries need new process heater designs and technologies to increase efficiency, reduce emissions, and improve cost/performance ratios.

Arthur D. Little, Inc. (ADL), working with ExxonMobil Research and Engineering Company (EMRE), Callidus Technologies, Inc., and GTI, is developing and demonstrating the technology base for a new generation of process heater that is both highly efficient and extremely low in emissions. The innovative system incorporates four advanced technologies: (1) ultra-low-emission (ULE) smart burners with real-time, close-coupled, air-fuel ratio sensing capability; (2) a specially designed fired heater with enhanced heat recovery, optimized for use with the ULE burner systems; (3) an on-line process tube temperature sensing and burner control system to enhance heat transfer, reduce maintenance costs, and increase run lengths; and (4) an adaptive Predictive Emissions Monitoring System (PEMS) to provide continuous emissions information without costly continuous emissions monitoring (CEMS) equipment.

TEST COMPONENTS OF INTEGRATED PROCESS HEATER SYSTEM



Test heaters and ultra-low-emission burner at Callidus Technologies.



Project Description

Goal: Project activities focus on the development of designs and components for an integrated process heater technology that maximizes system performance (in terms of efficiency, emissions, flexibility, reliability, and safety) while minimizing costs. A prototype ultra-low-emission burner (2 million Btu/hour) is being scaled up for commercial applications (9 million Btu/hour) and integrated with a low-cost, flame-ionization sensing system. The latter technology enables continuous monitoring of flame stability and the air/fuel ratio, which facilitates burner balancing to improve heat transfer and further lower emissions.

To capture near-term benefits, system components (burners, sensors, control systems, and heat exchangers) will also be designed for use in retrofit applications, either individually or in combination. If the technology is shown to be both technically and economically feasible, an integrated, commercial-scale retrofit system may be demonstrated at an ExxonMobil refinery.

Progress and Milestones

- Detailed in-flame data from Burner Engineering Laboratory (BERL) tests were used to develop and validate a reacting-flow, computational fluid dynamics (CFD) model of the ULE burner
- The CFD model was used to screen design options for the full-scale ULE burner and a detailed mechanical design for the full-scale burner was prepared.
- A prototype full-size burner was built and tested at Callidus.
- The ULE burner was optimized through testing and a commercial version was fabricated and tested at Callidus.
- A Burner User Group has been formed.
- A process heater at an ExxonMobil refinery was identified for a first-generation ULE burner field demonstration.
- Baseline performance data have been collected for the field demonstration heater.
- Fourteen field demonstration burners are in fabrication.
- Subscale flame ionization sensor technology tests were completed at ADL.
- Advanced process heater concepts have been identified.
- Field demonstration of the first-generation ULE burner scheduled to start in 2001.



PROJECT PARTNERS

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Callidus Technologies, Inc.

GTI

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